

**PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:  
SRIDHAR GOLLAMUDI

Serial No.: 09/851,858

Filed: May 9, 2001

For: METHOD FOR MULTIPLE ANTENNA  
TRANSMISSION USING PARTIAL  
CHANNEL KNOWLEDGE

Conf. No. 3687

Examiner: J. PERILLA

Group Art Unit: 2635

Att'y Docket: 2100.012200

Customer No. 46290

**REVISED APPEAL BRIEF**

Commissioner of Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Sir:

Applicant hereby submits this Appeal Brief to the Board of Patent Appeals and Interferences in response to the Notice of Non-Compliant dated July 14, 2009, for which the one-month date for response is August 14, 2009. This paper is being electronically filed on July 17, 2009, therefore it is timely filed.

It is believe that no fee is due at this time. However, should any additional fees be required for any reason to allow the filing of this Revised Appeal Brief the Commissioner is authorized to deduct said fees from **Williams, Morgan & Amerson's P.C. Deposit Account 50-0786/2100.012200.**

## **I. REAL PARTY IN INTEREST**

The present application is owned by Lucent Technologies, Inc. The assignment of the present application to Lucent Technologies, Inc., is recorded at Reel 11807, Frame 0733.

## **II. RELATED APPEALS AND INTERFERENCES**

Applicant is not aware of any related appeals and/or interferences that might affect the outcome of this proceeding.

## **III. STATUS OF THE CLAIMS**

Claims 1-36 are pending in the application and are the subject of the present appeal. Claims 8, 9, 14, and 15 stand rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by Harrison (U.S. Patent No. 6,154,485). Claims 1, 2, and 4-6 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Harrison. Claims 3, 7, 20, 29-31, and 35-36 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Harrison in view of Alamouti (U.S. Patent No. 6,185,258). Claim 10 stands rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Harrison in view of Dabak, et al (U.S. Patent No. 6,594,473). Claim 34 stands rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Harrison in view of Alamouti and in further view of Rice (U.S. Patent Application Publication No. 2002/0172260).

In the Final Office Action, the Examiner indicated that claims 11-13, 16-19, 21-28, and 32-33 contain allowable subject matter, but the Examiner objected to these claims as being dependent upon a rejected base claim. Appellant proposed rewriting claims 11, 16, and 32 in independent form including all the limitations of the base claim and any intervening claims.

However, the Examiner refused to enter these proposed amendments, as will be discussed in detail below.

#### **IV. STATUS OF AMENDMENTS**

In a response to the Final Office Action mailed April 27, 2005, Appellant proposed rewriting claims 11, 16, and 32 in independent form including all the limitations of the base claim and any intervening claims. Appellants also proposed amending other claims to address certain alleged informalities, as suggested by the Examiner. Appellants believe that these amendments complied with objections or requirements as to form and/or placed the application in condition for allowance or in better form for appeal. See MPEP §714.12. Accordingly, Applicants believe that the proposed amendments should have been entered by the Examiner. However, Appellants believe that the claims are allowable over the prior art of record even if these amendments are not entered. Accordingly, the arguments presented below will be based upon the claims as presented before the Final Office Action. For the convenience of the Board, the Claims Appendix will include the claims as presented before the Final Office Action, but these claims will also be marked up to show the proposed amendments.

#### **V. SUMMARY OF CLAIMED SUBJECT MATTER**

Independent claims 1, 4, 8, 21-23, and 26-29 set forth, among other things, generating a transformation matrix and/or a code correlation parameter based on an auto-correlation of a channel estimate. See Patent Application, page 9, ll. 22-32. Appellant notes that the auto-correlation function is a well-known mathematical function. See, *e.g.*, Bracewell, "The Autocorrelation Function," *The Fourier Transform and Its Applications*, 3rd ed. New York:

McGraw-Hill, pp. 40-45, 1999. An equivalent definition of the auto-correlation function is presented in the Patent Application on page 9 in lines 22-32.

The additional limitations of each independent claim are summarized below.

Claim 1 sets forth a method of encoding information symbols for multiple antennae transmission. The claimed method includes:

- generating a code matrix  $B_0$ . See Patent Application, page 7, ll. 1-12.
- generating a transformation matrix  $L$  based on an auto-correlation of a channel estimate. See Patent Application, page 7, line 13 – page 8, line 15.
- combining the code matrix  $B_0$  with the transformation matrix  $L$  to obtain a result  $B$  for controlling the amount of beamforming relative to the amount of orthogonal coding in signals transmitted from the multiple antennae. See Patent Application, page 8, line 15 – page 9, line 21.

Claim 4 sets forth a method of encoding information symbols for multiple antennae transmission. The claimed method includes:

- generating a code matrix  $B_0$ . See Patent Application, page 7, ll. 1-12.
- generating a transformation matrix  $L$  based on an auto-correlation of a channel estimate, where  $L$  satisfies the relationship  $\Phi = L^H L$ , and where  $\Phi$  is a desired correlation matrix. See Patent Application, page 7, line 13 – page 8, line 15.
- combining the code matrix  $B_0$  with the transformation matrix  $L$  to obtain a result  $B$  for controlling the amount of beamforming relative to the amount of orthogonal coding in signals transmitted from the multiple antennae. See Patent Application, page 8, line 15 – page 9, line 21.

Claim 8 sets forth a method of generating signals for transmitting from at least two antennae of a wireless communications system. The claimed method includes:

- feeding a stream of incoming information symbols to an encoder. See Patent Application, page 6, ll. 8-9.
- feeding a signal representative of a beamforming weight parameter to the encoder to modify the stream of information symbols. See Patent Application, page 6, ll. 21-31.
- determining a code correlation parameter ( $\lambda$ ) based on an auto-correlation of a channel estimate. See Patent Application, page 8, line 18 – page 9, line 21.
- feeding the code correlation parameter ( $\lambda$ ) to the encoder to control the proportion of orthogonal coding relative to beamforming of the stream of information symbols that are to be transmitted. See Patent Application, page 6, ll. 26-31.
- feeding the stream of information symbols modified by the code correlation parameter to at least two antennae for transmission. See Patent Application, page 6, ll. 26-31.

Claim 21 sets forth a method of generating signals for transmitting from at least two antennae of a wireless communications system. The claimed method includes:

- obtaining at least two component signals. See Patent Application, page 6, ll. 8-9.
- determining first and second complex numbers based upon an autocorrelation of a channel estimate. See Patent Application, page 7, line 13 – page 8, line 15.

- multiplying a first component signal by the first complex number to obtain a first signal. See Patent Application, page 7, line 13 – page 8, line 15.
- multiplying a second component signal by the second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal. See Patent Application, page 7, line 13 – page 8, line 15.
- subtracting the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.

Claim 22 sets forth a method of generating signals for transmitting from at least two antennae of a wireless communications system. The claimed method includes:

- obtaining at least two component signals. See Patent Application, page 6, ll. 8-9.
- determining first and second complex numbers based upon an autocorrelation of a channel estimate. See Patent Application, page 7, line 13 – page 8, line 15.
- multiplying a first component signal by the first complex number to obtain a first signal. See Patent Application, page 7, line 13 – page 8, line 15.
- multiplying a second component signal by the second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal. See Patent Application, page 7, line 13 – page 8, line 15.
- subtracting the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.

- multiplying a third component signal by the second complex number to obtain a third signal. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- multiplying a fourth component signal by the first complex number to obtain a fourth signal. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- adding the third signal to the fourth signal to obtain a second composite signal for transmission by the antenna element during a second transmit period. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.

Claim 23 sets forth a method of generating signals for transmitting from at least two antennae of a wireless communications system. The claimed method includes:

- obtaining at least two component signals. See Patent Application, page 6, ll. 8-9.
- determining first and second complex numbers based upon an autocorrelation of a channel estimate. See Patent Application, page 7, line 13 – page 8, line 15.
- multiplying a first component signal by the first complex number to obtain a first signal. See Patent Application, page 7, line 13 – page 8, line 15.
- multiplying a second component signal by the second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal. See Patent Application, page 7, line 13 – page 8, line 15.
- subtracting the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.

- multiplying a third component signal by the second complex number to obtain a third signal. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- multiplying a fourth component signal by the first complex number to obtain a fourth signal. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- adding the third signal to the fourth signal to obtain a second composite signal for transmission by the antenna element during a second transmit period. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- multiplying the first component signal by a third complex number to obtain a fifth signal. . See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- multiplying the second component signal by a fourth complex number to obtain a sixth signal, wherein the phases of the third and fourth complex numbers are unequal. . See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- adding the fifth signal to the sixth signal to obtain a third composite signal for transmission by the second antenna element during the first transmit period. . See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- multiplying the third component signal by the fourth complex number to obtain a seventh signal. . See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.



- multiplying the fourth component signal by the third complex number to obtain an 8th signal. . See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- subtracting the seventh signal from the 8th signal to obtain a fourth composite signal for transmission by the second antenna element during the second transmit period. . See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.

Claim 26 sets forth a method of forming a signal including the steps of:

- obtaining at least two component signals. See Patent Application, page 6, ll. 8-9.
- determining first and second phases based upon an autocorrelation of a channel estimate. See Patent Application, page 9, ll. 22-32.
- applying the first phase to a first component signal to obtain a first signal. See Patent Application, page 10, ll. 1-12.
- applying the second phase to a second component signal to obtain a second signal, wherein the first and second phases are unequal. See Patent Application, page 10, ll. 1-12.
- combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period. See Patent Application, page 10, ll. 13-25, as well as Tables 1-2.

Claim 27 sets forth a method of forming a signal including the steps of:

- obtaining at least two component signals. See Patent Application, page 6, ll. 8-9.
- determining first and second phases based upon an autocorrelation of a channel estimate. See Patent Application, page 9, ll. 22-32.
- applying the first phase to a first component signal to obtain a first signal. See Patent Application, page 10, ll. 1-12.
- applying the second phase to a second component signal to obtain a second signal, wherein the first and second phases are unequal. See Patent Application, page 10, ll. 1-12.
- combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period. See Patent Application, page 10, ll. 13-25, as well as Tables 1-2.
- applying the second phase to a third component signal to obtain a third signal. See Patent Application, page 10, ll. 1-12.
- applying the first phase to a fourth component signal to obtain a fourth signal. See Patent Application, page 10, ll. 1-12.
- combining the third signal and the fourth signal to obtain a second composite signal for transmission by the antenna element during a second transmit period. See Patent Application, page 10, ll. 13-25, as well as Tables 1-2.

Claim 28 sets forth a method of forming a signal including the steps of:

- obtaining at least two component signals. See Patent Application, page 6, ll. 8-9.

- determining first and second phases based upon an autocorrelation of a channel estimate. See Patent Application, page 9, ll. 22-32.
- applying the first phase to a first component signal to obtain a first signal. See Patent Application, page 10, ll. 1-12.
- applying the second phase to a second component signal to obtain a second signal, wherein the first and second phases are unequal. See Patent Application, page 10, ll. 1-12.
- combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period. See Patent Application, page 10, ll. 13-25, as well as Tables 1-2.
- applying the second phase to a third component signal to obtain a third signal. See Patent Application, page 10, ll. 1-12.
- applying the first phase to a fourth component signal to obtain a fourth signal. See Patent Application, page 10, ll. 1-12.
- combining the third signal and the fourth signal to obtain a second composite signal for transmission by the antenna element during a second transmit period. See Patent Application, page 10, ll. 13-25, as well as Tables 1-2.
- applying a third phase to the first component signal to obtain a fifth signal. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- applying a fourth phase to the second component signal to obtain a sixth signal, wherein third and fourth phases are unequal. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.

- combining the fifth and sixth signals to obtain a third composite signal for transmission by the second antenna element during the first transmit period;. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2. applying the fourth phase to the third component signal to obtain a seventh signal;
- applying the third phase to the fourth component signal to obtain an 8th signal. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.
- combining the fifth signal and the sixth signal to obtain a fourth composite signal for transmission by the second antenna element during the second time interval. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.

Claim 29 sets forth a method of encoding information symbols for multiple antennae transmission that includes the steps of:

- determining a plurality of orthogonal codes. See Patent Application, page 6, ll. 8-12.
- estimating at least one autocorrelation of at least one channel. See Patent Application, page 9, ll. 22-32.
- determining an amount of the beamforming relative to an amount of orthogonal coding and signals transmitted from the multiple antenna based upon the plurality of orthogonal codes and the at least one autocorrelation. See Patent Application, page 7, line 13 – page 8, line 15, and Tables 1-2.

## VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Appellant respectfully requests that the Board review and overturn the five rejections present in this case. The following issues are presented on appeal in this case:

- (A) Whether claims 8, 9, 14, and 15 are anticipated by Harrison;
- (B) Whether claims 1, 2, and 4-6 are obvious over Harrison;
- (C) Whether claims 3, 7, 20, 29-31, and 35-36 are obvious over Harrison in view of Alamouti;
- (D) Whether claim 10 is obvious over Harrison in view of Dabak; and
- (E) Whether claim 34 is obvious over Harrison in view of Alamouti and in further view of Rice.

## VII. ARGUMENT

### A. Legal Standards

An anticipating reference by definition must disclose every limitation of the rejected claim in the same relationship to one another as set forth in the claim. *In re Bond*, 15 U.S.P.Q.2d 1566, 1567 (Fed. Cir. 1990).

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, the prior art reference (or references when combined) must teach or suggest all the claim limitations. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (CCPA 1974). Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. That is, there must be something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination. *Panduit Corp. v. Dennison Mfg. Co.*, 810

F.2d 1561 (Fed. Cir. 1986). In fact, the absence of a suggestion to combine is dispositive in an obviousness determination. *Gambro Lundia AB v. Baxter Healthcare Corp.*, 110 F.3d 1573 (Fed. Cir. 1997). The mere fact that the prior art can be combined or modified does not make the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 916 F.2d 680, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990); M.P.E.P. § 2143.01. Third, there must be a reasonable expectation of success.

The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991); M.P.E.P. § 2142. A recent Federal Circuit case emphasizes that, in an obviousness situation, the prior art must disclose each and every element of the claimed invention, and that any motivation to combine or modify the prior art must be based upon a suggestion in the prior art. *In re Lee*, 61 U.S.P.Q.2d 143 (Fed. Cir. 2002). Conclusory statements regarding common knowledge and common sense are insufficient to support a finding of obviousness. *Id.* at 1434-35. Moreover, it is the claimed invention, as a whole, that must be considered for purposes of determining obviousness. A mere selection of various bits and pieces of the claimed invention from various sources of prior art does not render a claimed invention obvious, unless there is a suggestion or motivation in the prior art for the claimed invention, when considered as a whole.

It is by now well established that teaching away by the prior art constitutes *prima facie* evidence that the claimed invention is not obvious. *See, inter alia, In re Fine*, 5 U.S.P.Q.2d (BNA) 1596, 1599 (Fed. Cir. 1988); *In re Nielson*, 2 U.S.P.Q.2d (BNA) 1525, 1528 (Fed. Cir. 1987); *In re Hedges*, 228 U.S.P.Q. (BNA) 685, 687 (Fed. Cir. 1986).

**B. Claims 8-9 and 14-15 Are Not Anticipated by Harrison.**

Harrison is concerned with receiving signals using combined orthogonal transmit diversity and adaptive array techniques. Harrison describes a coefficient  $\alpha$  that may allow a base transmitter to smoothly transition between orthogonal transmit diversity mode and adaptive array mode. This smooth transition may allow the base transmitter to smoothly disable the adaptive array mode in proportion to the degradation of the quality of feedback data from a receiver. See Harrison, col. 8, ll. 23-35.

However, Harrison does not describe or suggest determining a code correlation parameter ( $\lambda$ ) based on an auto-correlation of a channel estimate, as set forth in independent claim 8. In the Advisory Action, the Examiner alleges the measurement of the channel characteristics of a pair of channels described by Harrison is an autocorrelation of the channel estimates of the channels. Appellant disagrees. Simply measuring channel characteristics does not constitute performing an autocorrelation of a channel characteristic. Furthermore, Appellant notes that the Examiner's reasoning betrays a fundamental misunderstanding of the meaning of the term "autocorrelation" because an autocorrelation function is applied to a single signal and/or data stream, and not to a pair of channel estimates. For at least this reason, Applicants respectfully submit that claim 8, and claims 9, 14, and 15 depending therefrom, are not anticipated by Harrison. Applicants request that the Examiner's rejections of claims 8, 9, 14, and 15 under 35 U.S.C. § 102(e) be REVERSED.

**C. Claims 1, 2, and 4-6 are not obvious over Harrison.**

As discussed above, Harrison describes a coefficient  $\alpha$  that may allow a base transmitter to smoothly transition between orthogonal transmit diversity mode and adaptive array mode. However, Harrison is completely silent with regard to generating a transformation matrix based on an auto-correlation of a channel estimate, as set forth in independent claims 1 and 4. Moreover, as admitted by the Examiner, Harrison does not explicitly disclose an orthogonal code matrix, as set forth in independent claims 1 and 4. For at least the aforementioned reasons, Appellants respectfully submit that claims 1-2 and 4-6 are not obvious over Harrison and request that the Examiner's rejections of claims 1-2 and 4-6 under 35 U.S.C. 103(a) be REVERSED.

**D. Claims 3, 7, 20, 29-31, and 35-36 are not obvious over Harrison in view of Alamouti.**

As discussed above, Harrison describes a coefficient  $\alpha$  that may allow a base transmitter to smoothly transition between orthogonal transmit diversity mode and adaptive array mode. However, Harrison is completely silent with regard to generating a transformation matrix based on an auto-correlation of a channel estimate, as set forth in independent claims 1 and 4. Moreover, as admitted by the Examiner, Harrison does not explicitly disclose an orthogonal code matrix, as set forth in independent claims 1 and 4. Harrison is also completely silent with regard to determining a code correlation parameter ( $\lambda$ ) based on an auto-correlation of a channel estimate, as set forth in independent claim 8. Furthermore, Harrison is completely silent with regard to estimating an auto-correlation of a channel, as set forth in independent claim 29.

The Examiner relies upon Alamouti to describe generation of an orthogonal code matrix. However, Alamouti fails to remedy the fundamental deficiencies of the primary reference.



Moreover, none of the cited references provide any suggestion or motivation to modify the prior art to arrive at Applicants claimed invention. For at least the aforementioned reasons, Applicants respectfully submit that the present invention is not obvious over Harrison and Alamouti, either alone or in combination. Applicants request that the Examiner's rejections of claims 3, 7, 20, 29-31 and 35-36 under 35 U.S.C. 103(a) be REVERSED.

**E. Claim 10 is not obvious over Harrison in view of Dabak.**

Claim 10 depends from claim 8. As discussed above, Harrison describes a coefficient  $\alpha$  that may allow a base transmitter to smoothly transition between orthogonal transmit diversity mode and adaptive array mode. However, Harrison is also completely silent with regard to determining a code correlation parameter ( $\lambda$ ) based on an auto-correlation of a channel estimate, as set forth in independent claim 8.

The Examiner relies upon Dabak to describe a complex beamforming weight parameter having a magnitude and a phase. However, Dabak fails to remedy the fundamental deficiencies of the primary reference. Moreover, none of the cited references provide any suggestion or motivation to modify the prior art to arrive at Applicants claimed invention. For at least the aforementioned reasons, Applicants respectfully submit that the present invention is not obvious over Harrison and Dabak, either alone or in combination. Applicants request that the Examiner's rejections of claim 10 under 35 U.S.C. 103(a) be REVERSED.

**F. Claim 34 is not obvious over Harrison in view of Alamouti and in further view of Rice.**

Claim 34 depends from claim 29. As discussed above, Harrison describes a coefficient  $\alpha$  that may allow a base transmitter to smoothly transition between orthogonal transmit diversity mode and adaptive array mode. However, Harrison is completely silent with regard to estimating an auto-correlation of a channel, as set forth in independent claim 29.

The Examiner relies upon Rice to describe using a look up table. However, Rice fails to remedy the fundamental deficiencies of the primary reference. Moreover, none of the cited references provide any suggestion or motivation to modify the prior art to arrive at Applicants claimed invention. For at least the aforementioned reasons, Applicants respectfully submit that the present invention is not obvious over Harrison and Rice, either alone or in combination. Applicants request that the Examiner's rejections of claim 34 under 35 U.S.C. 103(a) be REVERSED.

## **VIII. CLAIMS APPENDIX**

The claims that are the subject of the present appeal – claims 1-36 – are set forth in the attached “Claims Appendix.”

## **IX. EVIDENCE APPENDIX**

There is no separate Evidence Appendix for this appeal.

## **X. RELATED PROCEEDINGS APPENDIX**

There is no Related Proceedings Appendix for this appeal.

## **XI. CONCLUSION**

In view of the foregoing, it is respectfully submitted that the Examiner erred in not allowing all claims pending in the present application, claims 1-28, over the prior art of record. The undersigned may be contacted at (713) 934-4052 with respect to any questions, comments or suggestions relating to this appeal.

Respectfully submitted,

Date: June 10, 2009

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AGENT FOR APPLICANTS

## **CLAIMS APPENDIX**

1. (Previously Presented) A method of encoding information symbols for multiple antennae transmission comprising the steps of:

generating a code matrix  $B_0$ ;

generating a transformation matrix  $L$  based on an auto-correlation of a channel estimate;

and

combining the code matrix  $B_0$  with the transformation matrix  $L$  to obtain a result  $B$  for controlling the amount of beamforming relative to the amount of orthogonal coding in signals transmitted from the multiple antennae.

2. (Previously Presented) The method of claim 1 wherein the transformation matrix  $L$  is a matrix such that the conjugate transpose of  $L$  multiplied by  $L$  generates a desired correlation matrix  $\Phi$ .

3. (Original) The method of claim 2 wherein the code matrix  $B_0$  is orthogonal.

4. (Previously Presented) A method of encoding information symbols for multiple antennae transmission comprising the steps of:

generating a code matrix  $B_0$ ;

generating a transformation matrix  $L$  based on an auto-correlation of a channel estimate,

where  $L$  satisfies the relationship  $\Phi = L^H L$ , and where  $\Phi$  is a desired correlation matrix; and

combining the code matrix  $B_0$  with the transformation matrix  $L$  to obtain a result  $B$  for controlling the amount of beamforming relative to the amount of orthogonal coding in signals transmitted from the multiple antennae.

5. (Original) The method of claim 4 wherein the desired correlation matrix is comprised of at least one correlation parameter  $\lambda$ .

6. (Original) The method of claim 5 wherein the transformation matrix  $L$  is the matrix square root of the desired correlation matrix  $\Phi$ .

7. (Original) The method of claim 4 wherein blocks of symbols of a serial data stream of user data are encoded with an orthogonal code to form code matrix  $B_0$ .

8. (Previously Presented) A method of generating signals for transmitting from at least two antennae of a wireless communications system comprising the steps of:

feeding a stream of incoming information symbols to an encoder;

feeding a signal representative of a beamforming weight parameter to the encoder to modify the stream of information symbols;

determining a code correlation parameter ( $\lambda$ ) based on an auto-correlation of a channel estimate;

feeding the code correlation parameter ( $\lambda$ ) to the encoder to control the proportion of orthogonal coding relative to beamforming of the stream of information symbols that are to be transmitted; and

feeding the stream of information symbols modified by the code correlation parameter to at least two antennae for transmission.

9. (Original) The method of claim 8 wherein the code correlation parameter determines the correlation of the encoded signals to the different antennae.

10. (Original) The method of claim 9 wherein the signal representative of the beamforming weight parameter represents a complex number having a magnitude and a phase.

11. (Original) The method of claim 9 wherein the signal representative of the beamforming weight parameter is a real number portion of a phase of the beamforming weight parameter.

12. (Previously Presented) The method of claim 11 wherein the code correlation parameter is a real number that can vary between a first value and a second value.

13. (Original) The method of claim 12 wherein one of the values represents orthogonal coding with no beamforming and the other value represents beamforming with no orthogonal coding, and intermediate values represent a combination of orthogonal coding and beamforming.

14. (Original) The method of claim 9 wherein, in a duplex communication system having a forward and reverse link, the code correlation parameter is determined from signals received on the reverse link.

15. (Original) The method of claim 14 further comprising the step of determining a channel correlation coefficient ( $\rho$ ) from the signals received on the reverse link.

16. (Original) The method of claim 15 wherein the channel correlation coefficient ( $\rho$ ) is a complex number from which the magnitude component and not the phase component is used to determine the code correlation parameter  $\lambda$ .

17. (Original) The method of claim 15 wherein the channel correlation coefficient is an estimate of an auto-correlation coefficient of channel gain from an antenna for a fixed time delay.

18. (Original) The method of claim 17 wherein the delay is determined by the difference between the time at which feedback information is transmitted on the reverse link to the time at which the beamforming weight parameter computed using that information is applied by a forward link transmitter.

19. (Original) The method of claim 18 wherein the delay is equal to the time difference multiplied by the ratio of carrier frequencies on the reverse and forward links.

20. (Previously Presented) The method of claim 8 wherein the signal transmitted by each antenna at each symbol time is the sum of one or more signals, each of which is proportional to the product of one of the incoming information symbols and their complex conjugates and their

negations and their negations of their complex conjugates, with a number that is determined by the code correlation parameter ( $\lambda$ ).

21. (Previously Presented) A method of forming a signal comprising the steps of:
  - obtaining at least two component signals;
  - determining first and second complex numbers based upon an autocorrelation of a channel estimate;
  - multiplying a first component signal by the first complex number to obtain a first signal;
  - multiplying a second component signal by the second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal; and
  - subtracting the second signal from the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period.
  
22. (Previously Presented) A method of forming signals for transmission from an antenna element during two transmit periods comprising the steps of:
  - obtaining at least two component signals for each transmit period;
  - multiplying a first component signal by a first complex number to obtain a first signal;
  - multiplying a second component signal by a second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal;
  - subtracting the second signal from the first signal to obtain a first composite signal for transmission by the first antenna element during a first transmit period;
  - multiplying a third component signal by the second complex number to obtain a third signal;



multiplying a fourth component signal by the first complex number to obtain a fourth signal; and

adding the third signal to the fourth signal to obtain a second composite signal for transmission by the antenna element during a second transmit period.

23. (Previously Presented) A method of forming signals for transmission from two antenna elements during two transmit periods comprising the steps of:

obtaining at least two component signals for each antenna for each time interval;

multiplying a first component signal by a first complex number to obtain a first signal;

multiplying a second component signal by a second complex number to obtain a second signal, wherein the phases of the first and second complex numbers are unequal;

subtracting the second signal from the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period;

multiplying a third component signal by the second complex number to obtain a third signal;

multiplying a fourth component signal by the first complex number to obtain a fourth signal;

adding the third signal to the fourth signal to obtain a second composite signal for transmission by the first antenna element during a second transmit period;

multiplying the first component signal by a third complex number to obtain a fifth signal;

multiplying the second component signal by a fourth complex number to obtain a sixth signal, wherein the phases of the third and fourth complex numbers are unequal;

adding the fifth signal to the sixth signal to obtain a third composite signal for transmission by the second antenna element during the first transmit period;

multiplying the third component signal by the fourth complex number to obtain a seventh signal;

multiplying the fourth component signal by the third complex number to obtain an 8th signal; and

subtracting the seventh signal from the 8th signal to obtain a fourth composite signal for transmission by the second antenna element during the second transmit period.

24. (Original) The method of claim 23 wherein the component signals are determined by at least one incoming information symbol and at least one of the component signals is related to a code correlation parameter.

25. (Original) The method of claim 24 wherein each component signal is related to at least one of two information symbols, or their negations, or their complex conjugates or the negations of their complex conjugates.

26. (Previously Presented) A method of forming a signal comprising the steps of:  
obtaining at least two component signals;  
determining first and second phases based upon an autocorrelation of a channel estimate;  
applying the first phase to a first component signal to obtain a first signal;  
applying the second phase to a second component signal to obtain a second signal,  
wherein the first and second phases are unequal; and

combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first transmit period.

27. (Previously Presented) A method of forming signals for transmission from an antenna element during two transmit periods comprising the steps of:

obtaining at least two component signals for each transmit period;

applying a first phase to a first component signal to obtain a first signal;

applying a second phase to a second component signal to obtain a second signal, wherein the first and second phases are unequal;

combining the second signal and the first signal to obtain a first composite signal for transmission by the first antenna element during a first transmit period;

applying the second phase to a third component signal to obtain a third signal;

applying the first phase to a fourth component signal to obtain a fourth signal; and

combining the third signal and the fourth signal to obtain a second composite signal for transmission by the antenna element during a second transmit period.

28. (Previously Presented) A method of forming signals for transmission from two antenna elements during two time intervals comprising the steps of:

obtaining at least two component signals for each antenna for each time interval;

applying a first phase to a first component signal to obtain a first signal;

applying a second phase to a second component signal to obtain a second signal, wherein the first and second phases are unequal;

combining the second signal and the first signal to obtain a first composite signal for transmission by a first antenna element during a first time interval;

applying the second phase to a third component signal to obtain a third signal;

applying the first phase to a fourth component signal to obtain a fourth signal;

combining the third signal and the fourth signal to obtain a second composite signal for transmission by the first antenna element during a second time interval;

applying a third phase to the first component signal to obtain a fifth signal;

applying a fourth phase to the second component signal to obtain a sixth signal, wherein third and fourth phases are unequal;

combining the fifth and sixth signals to obtain a third composite signal for transmission by the second antenna element during the first transmit period;

applying the fourth phase to the third component signal to obtain a seventh signal;

applying the third phase to the fourth component signal to obtain an 8th signal; and

combining the fifth signal and the sixth signal to obtain a fourth composite signal for transmission by the second antenna element during the second time interval.

29. (Previously Presented) A method of encoding information symbols for multiple antenna transmission comprising the steps of:

determining a plurality of orthogonal codes;

estimating at least one autocorrelation of at least one channel; and

determining an amount of the beamforming relative to an amount of orthogonal coding and signals transmitted from the multiple antenna based upon the plurality of orthogonal codes and the at least one autocorrelation.

30. (Previously Presented) The method of claim 29, wherein determining the plurality of orthogonal codes comprises determining a code matrix, and wherein each column of the code matrix is associated with one of the plurality of orthogonal codes such that the columns are orthogonal to each other.

31. (Previously Presented) The method of claim 29, wherein estimating the at least one autocorrelation of the at least one channel comprises estimating at least one autocorrelation of at least one reverse link channel.

32. (Previously Presented) The method of claim 29, wherein estimating the at least one autocorrelation comprises determining at least one round-trip delay associated with the at least one channel.

33. (Previously Presented) The method of claim 32, wherein estimating the at least one autocorrelation comprises determining at least one autocorrelation of the at least one channel for the at least one round-trip delay.

34. (Previously Presented) The method of claim 29, wherein determining the amount of beamforming relative to the amount of orthogonal coding comprises accessing a lookup table.

35. (Previously Presented) The method of claim 29, comprising encoding at least one symbol using the determined amount of beamforming and orthogonal coding.

36. (Previously Presented) The method of claim 35, comprising transmitting the at least one encoded symbol using the determined amount of beamforming and orthogonal coding.